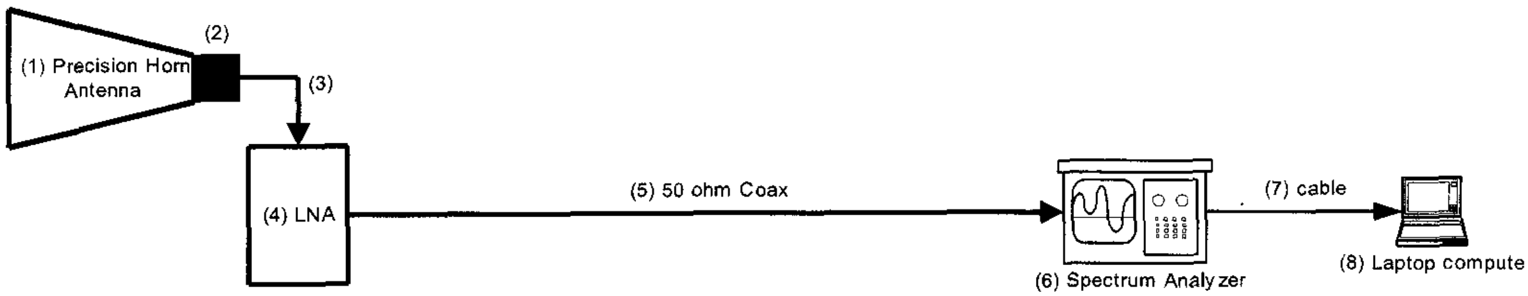
The receiver was calibrated using synthesizer (9) and spectrum analyzer (6). Subsequent to calibration of the spectrum analyzer, the HP/E8247C synthesizer was connected to the spectrum analyzer via (3), (4), and (5). Using the synthesizer a –50dBm signal was generated at various frequencies centered around 12.45 GHz and measured by the spectrum analyzer.

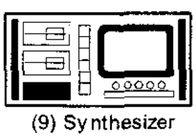
Table 1 shows the median value of calibration measurements for three different LNAs used in the Albuquerque test. LNAs with different gains do not impact the over all normalized results of the field strength, as the field strength is independent of the receiver set total gain, however, a separate normalization factor is required in the calculation of field strength for each LNA. As shown in Figure 1 the horn antenna has a 23.5 dB gain over isotropic, thus the receiver set total gain is the linear addition of the of gains in Table 1 and the horn antenna gain.

LNA	**Synthesizer Signal Level (dBm) @ 12.45 GHz**	**Spectrum Analyzer Level (dBm)**	**Gain (dB)**	**Total Gain Including the Antenna**
RFLNA15G35DB	-50	-22.75	27.25	50.75
RFLNA15G42DB	-50	-13.21	36.79	60.29
JCA1218-F01	-50	-30.86	19.14	42.64

Table 1 Test set receiver calibration

As the MDS transmitter transmits on both vertical and horizontal polarization simultaneously, and as each calibrated test set can only receive one polarization at the time, two calibrated test sets were configured to receive simultaneously and separately each polarization. However, each calibrated test set is connected to the same computer, using two separate RS-232 commutation port.





(1) MI-12-12 Standard Gain Horn Antenna , 23.5 dB gain @12.5 GHz, Beamwidth- 10 Deg. H-Plane, 9 Deg. E-Plane

(2) Narda 4609 Waveguide to SMA (F) coaxial adapters

(3) Andrew LDF2P-50 SMA(M) 6ft, Attenuation: 0.94 dB @12.5 GHz

(4) JCA1218-F01, 22 dB Min. Low Noise Amplifier

(4b) RFLNA15G35DB, 35 dB Min. Low Noise Amplifier

(4c) RFLNA15G42DB, 42dB Min. Low Noise Amplifier

(5) Andrew EFX2-50 SMA(M) 40ft, Attenuation: 6.5 dB @12.5 GHz

(6) HP E4407B/1AX/1DN/AYT/AYX/B75/B7B/BAA/UK9 26.5 GHz SA

(7) HP 24542U compatible Serial Cable

(8) PC compatible Laptop computer with Analytic Consulting software

(9) E8247C/520/1E1/1EA/1ED 20GHz Synthesizer, used for calibration

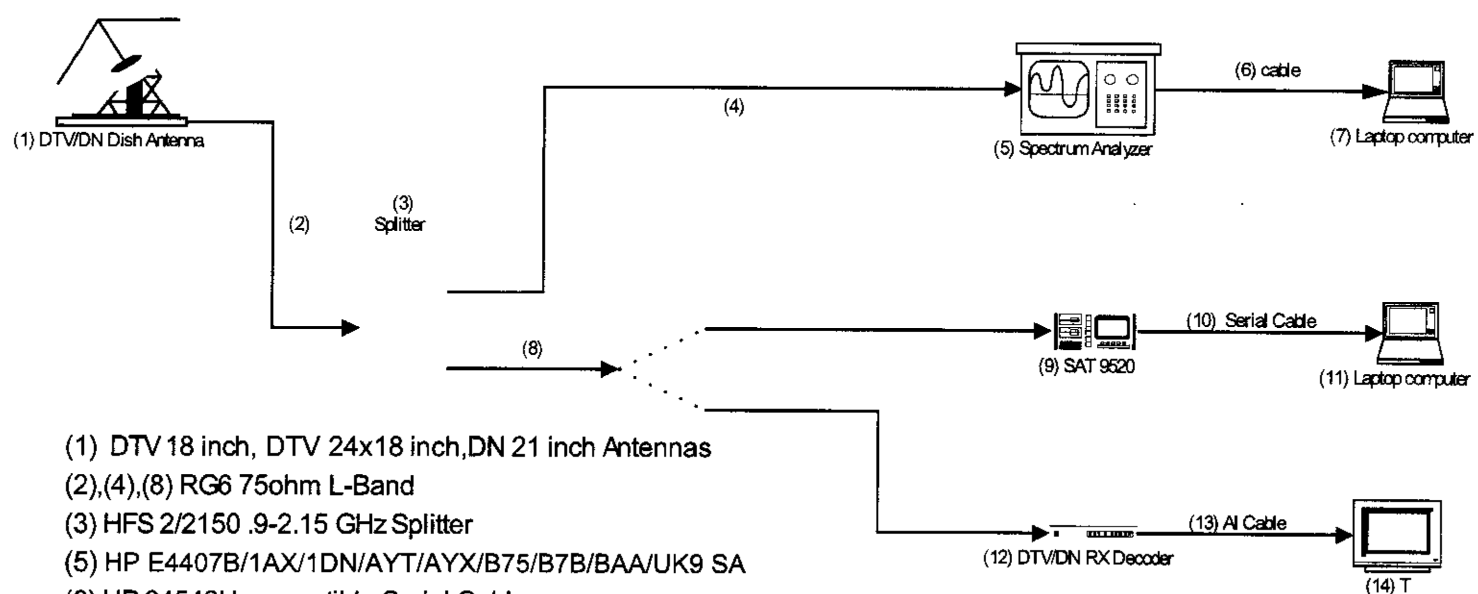
Figure 1 MDS receiver set

3.2 DBS Receivers

The two DBS systems tested were DirecTV (DTV) and Dish Network (DN). The receiver equipment for the DTV was model DirecTV® D10 and model DISH311 for DN. Each DBS receiving system includes a dish antenna and a combined receiver decoder (RX/DEC) as shown in Figure 2. The antennas used for the DTV signal reception were an eighteen inch dish with a single Low Noise Block (LNB) converter that converted the Ku-band (12.2-12.7 GHz) satellite signal to L-band (0.950-1.450 GHz), and a 24-by-18 inch reflector with triple LNB feed. The antenna used for DN was a twenty-one inch dish with a dual LNB feed. Satellite signal from the antenna was split using (3) to provide signal to the spectrum analyzer, SAT9520, and DBS RX/DEC.

The splitter had a D.C. pass from one of the outputs to the input, which allowed for the D.C. power passage to the LNB. The D.C. block output from the splitter (3) was directly connected to the spectrum analyzer (5) via (4). The D.C. pass output of the splitter was shared between the SAT-9520 and the DBS RX/DEC. During the data collection, SAT-9520 was connected to the D.C. pass output of the splitter via (8) and the power for the LNB was supplied by it. Similarly, during the picture observation, RX/DEC was connected to the D.C. pass output of the splitter. Further details regarding components and equipment model number are presented in Figure 2.

The spectrum analyzer was connected to a laptop (7) via a serial cable (6). ACS's software was used to retrieve data from the spectrum analyzer and stored for later retrieval. Likewise, the SAT-9520 was connected to a laptop by an Applied Instrument (AI) serial cable (13) and data was collected by AI's software and stored for later retrieval.



(1) DTV 18 inch, DTV 24x18 inch,DN 21 inch Antennas
(2),(4),(8) RG6 75ohm L-Band
(3) HFS 2/2150 .9-2.15 GHz Splitter
(5) HP E4407B/1AX/1DN/AYT/AYX/B75/B7B/BAA/UK9 SA
(6) HP 24542U compatible Serial Cable
(7) PC compatible Laptop computer with Analytic Consulting software
(9) Applied Instruments DBS Signal Level Meter Model SAT 9520
(10) Applied Instruments SAT 9520 data transfer cable
(11) PC compatible Laptop computer with Applied Instrument software
(12) DTV/DN Receiver and Decoder
(13) RCA Cable
(14) Television set

Figure 2 DBS Receiver set

3.3 MDS Receiver Set

The MDS receiver set included a receiver/decoder and a flat panel antenna with an attached LNB. The total gain of the antenna system varied from 50-95 dB (30 dB antenna + 20 - 65 dB LNB).

4 MDS Transmitter

4.1 MDS Transmission Equipment[1]

MDS América's transmission equipment employed for the Albuquerque test can be logically divided into three functional groups. Group 1 provides video content in DVB MPEG-2 format, while group 2 modulates the carrier with the content of group 1, and group 3 transmits the modulated signal from group 2 into propagating vertical and horizontal electromagnetic waves.

As shown in Figure 3, A DVD player running in loop mode supplies the video content. Analog output signal of the DVD player is directed to an encoder, which converts the analog video and audio signals into DVB MPEG-2 ASI format. An ASI distribution amplifier provides distribution, timing and processing of the signal.

Output of each ASI distribution amplifier channel is modulated into DVB-S compliant QPSK signal, with each polarization having one modulator per channel for a total of 6 modulators.

The QPSK outputs of each polarization are directed into a combiner to form an intermediate signal, which is then fed into a Solid State Power Block (SSPB) converter to amplify and upconvert the intermediate signal in to the Ku-band RF signal. An elliptical waveguide is subsequently used to feed the RF signal of each polarization into a sectorial transmission antenna having both vertical and horizontal port.

All the pertinent equipment are placed in a rack mount cabinet, along with a rack mount computer running a remote access software to facilitate full control over the SSPB remotely using SNMP agents.

[1] The information in this subsection was provided by Grigory Kholodkov from MDS America.

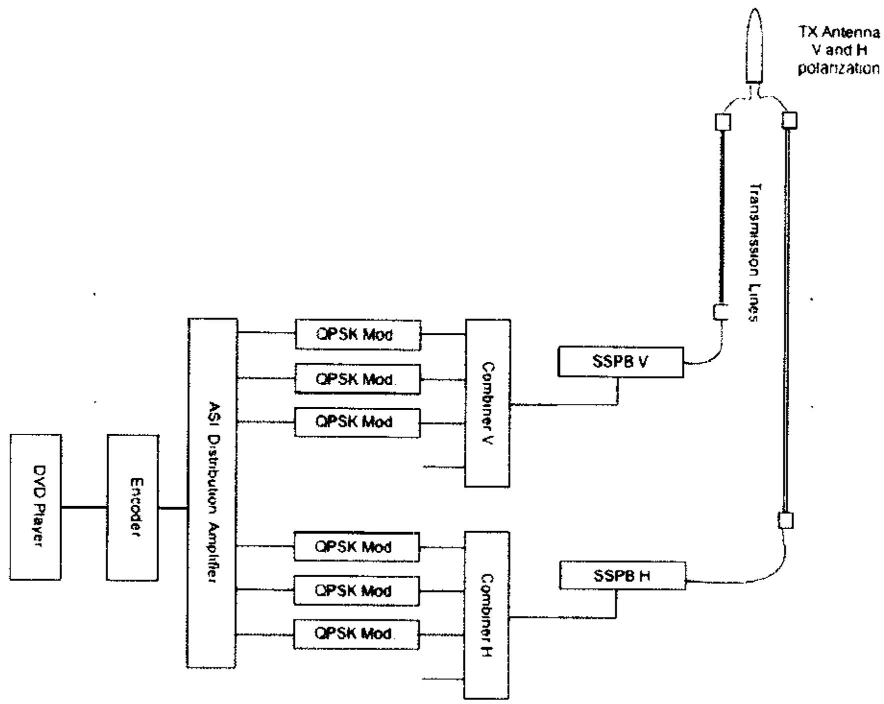


Figure 3 MDS transmitter in Albuquerque

4.2 MDS Transmission Configuration

MDSA's Antenna was installed on an existing telecommunications tower in Sandia Park at a height of 30 meters (AGL), as shown in Figure 4 - Figure 5. The base of the tower is on an altitude of 3239 meters (10,626 ft) over the Mean Sea Level (MSL) overlooking Albuquerque and the surrounding area.

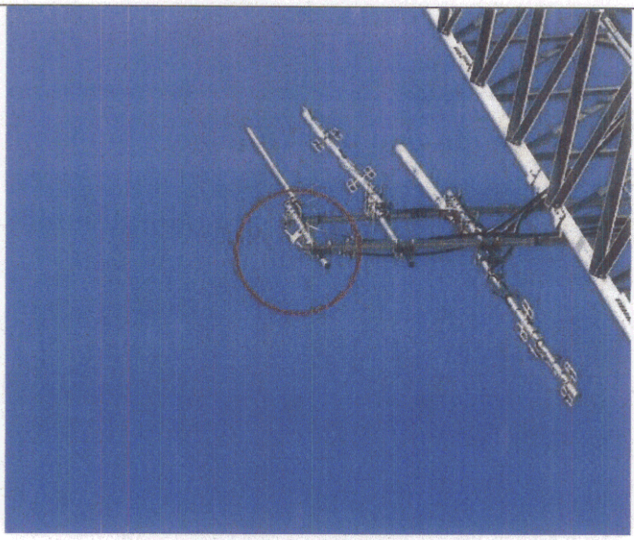


Figure 4 MDS Antenna – side view

Figure 5 MDS Antenna installed on the Global tower

MDS transmitter configuration for the Albuquerque test consisted of three channels per each linear polarization, each channel having 3 dB bandwidth of 20 MHz and separated from adjacent channel by approximately 30 MHz. DBS operators generally have a maximum of 16 transponders per left and right circular polarization with each transponder also having a 3 dB bandwidth of 20 MHz and similarly separated from adjacent co-polarized transponders by approximately 30MHz. As shown in Figure 6, the center frequency of each MDS channel (yellow trapezoids) in each polarization has a minimum separation of 7 MHz from the center frequency of each DBS transponder (green trapezoids), so as to minimize the interference to DBS.

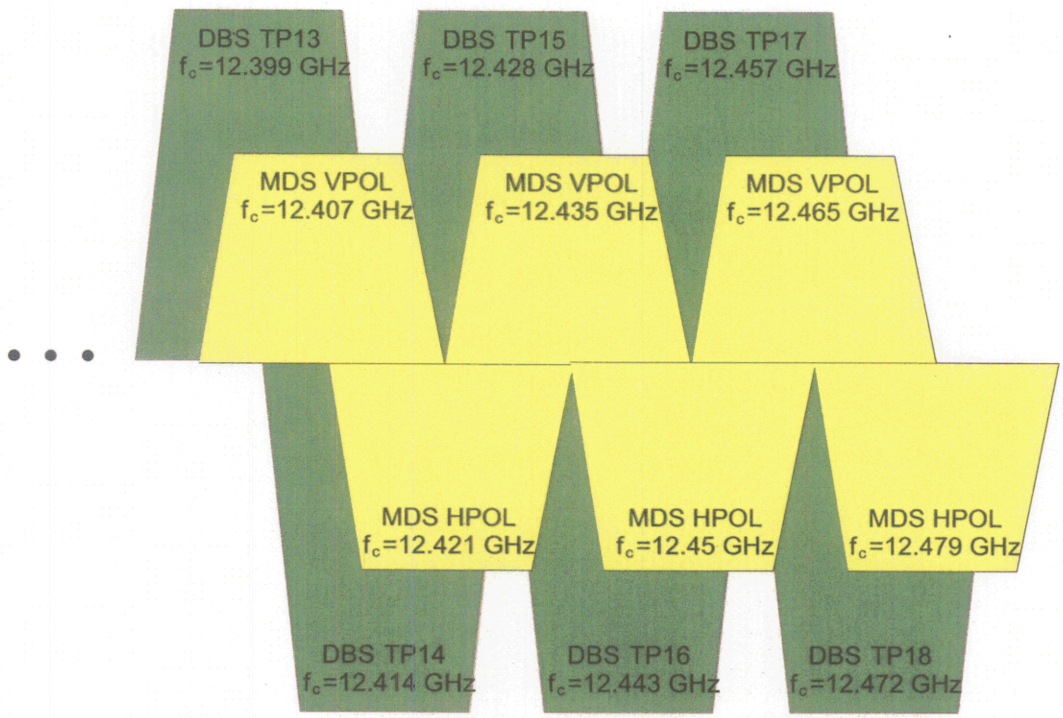


Figure 6 MDS signal in reference to the LC and RC polarized Satellite signal

This particular configuration positions the inter-channel separation between adjacent MDS channels within the DBS transponder thus reducing the power that can cause interference to it. For example, the MDS channels that can be potential cause of interference to DBS transponder 15 (TP15) consist of 2 channels per polarization, MDS channels 12.434 GHz and 12.407 GHz in vertical polarization, and MDS channels 12.421 GHz and 12.45 GHz in horizontal polarization. Because of the positioning of the MDS inter-channel separation, the total MDS horizontal polarization power within the TP15 band is less than the power of one MDS channel, assuming equal power for MDS channels 12.421 GHz and 12.45 GHz. Similarly, the total MDS vertical polarization power within the TP15 band is also less than the power of one MDS channel. Thus, the total MDS power with the TP15 is less than the power in two MDS channels assuming all channels of equal power.

Figure 7 MDS antenna orientation

Per ACS request, the power transmitted by each MDS channel was initially set to the maximum of 44 dBm Effective Isotropic Radiated Power (EIRP) and subsequently changed to various other lower levels as warranted by the test scenario. Figure 8 through Figure 11 show MDS antenna pattern associated with this transmitter at 12.75 GHz. Using the antenna patterns a simple Free Space Path Loss (FSPL) model was created to provide an expected estimate of power flux density at each site.

As shown in Figure 7 MDS antenna orientation, the MDS transmit antenna is pointed 230° with respect to true North, and down tilted approximately – 4.5° in elevation, so as to direct the main beam toward downtown Albuquerque. This orientation of the antenna is well suited for coverage of Albuquerque and surrounding area, and as such, is a realistic deployment scenario for this DMA. Moreover, this particular orientation places the spill over region of DBS antennas directly in the path of the main beam of MDS transmit antenna, consequently providing for the worst-case interference scenario.

As will be discussed later in this report, during the performance of measurement, occasionally the measured power from the MDS transmitter seemed somewhat out of line with the FSPL prediction, and also inconsistent across polarization for a given transmit power. This was primarily an issue of the vertical polarization of MDS transmitter. As power flux density is calculated and presented in the plots and tables to follow, this condition does not affect the overall results.

In general, FSPL prediction of received power seemed very accurate within the main beam and not as accurate off the beam. One reason for this is that the FSPL is based on the MDS antenna pattern at 12.75 GHz, and as such, the locations of antenna nulls away from the mean beam tend to differ from nulls of the operating frequency of H-POL (12.45 GHz) and V-POL (12.435 GHz) of the MDS transmitter.